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贵州睦化泥盆系—石炭系界线剖面的鱼类微化石

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关键词 贵州睦化 泥盆系—石炭系界线鱼类微化石

内 容 提 要

本文记述了贵州睦化泥盆系—石炭系界线上、下两个层位中所发现的7个属种的软骨鱼类、棘鱼类的牙齿和鳞片等微化石，建立了代化瓣齿鲨（*Petalodus daihuaensis*, sp. nov.）和贵州棘鱼（*Acanthodes guizhouensis*, sp. nov.）两个新种。通过研究，划分出两个鱼类微化石组合：1.上泥盆统顶部（法门阶）以 *Phoebotus politus* 为代表的鲨类化石组合；2.下石炭统底部（杜内阶早期）贵州棘鱼化石组合。

睦化剖面根据牙形石的研究，泥盆系—石炭系的界线在 *Siphonodelle praesulcata* 化石带和 *S. sulcata* 化石带之间。本文记述的鲨类化石组合发现在睦化剖面代化组的最顶部（GM1120, 1121），相当于 *Siphonodelle praesulcata* 化石带；贵州棘鱼发现于格董关层（GM1124），在界线之上。在睦化，以及在其他各地，*Phoebodus* 和 *Harpagodens Fero* 这样的鲨类皆发现于晚泥盆世。而 *Acanthodes* 属则从 *Siphonodelle sulcata* 带起才出现，未发现于更老的地层中。因此 *Acanthodes* 属的最早出现可能也是石炭系底界的标志。

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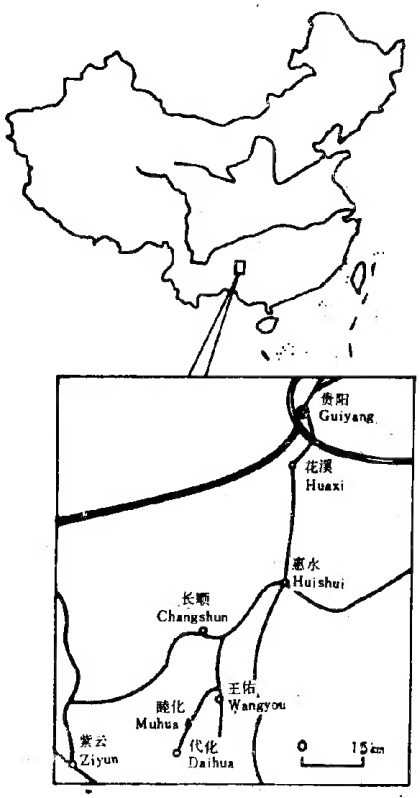

图1 贵州南部王佑—代化区交通位置图

fig. 1 Location map of the Wangyou-Daihua area, South Guizhou

VERTEBRATE MICROFOSSILS OF THE DEVONIAN-CARBONIFEROUS BOUNDARY, MUHUA SECTION, GUIZHOU PROVINCE

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Key words Muhua Guizhou; Devonian-Carboniferous boundary; chondrichthyans acanthodians microfossils

Introduction

The Muhua section of Changshun County, Guizhou Province, is ideal for the Devonian-Carboniferous boundary stratotype in China. The section is divided into four formations, the Daihua, Wangyou (on the bottom includes the Gedongguan Bed), Muhua and Dawuba (see Hou et al. 1985). On the basis of conodont evidence it can be determined that the Devonian-Carboniferous boundary passes between the *Siphonodella praesulcata* and *S. sulcata* zones which are within the Gedongguan Bed (Hou et al.1985, Stratigraphic part).

The vertebrates were obtained from rock samples during searches for conodonts in acetic-acid prepared residues. In this paper we shall examine the microvertebrate assemblages and discuss their usefulness in assessing the age of the section and in defining the Devonian-Carboniferous boundary.

Vertebrate Remains

Three vertebrate-bearing horizons have been found in the Muhua section; these are from samples designated GMII20, 21 and 24. The vertebrate microfossils include teeth and scales from at least two major groups of fish-elasmobranchs and acanthodians. The remains are assigned as follows:

A. ACANTHODIANS——scales of *Acanthodes guizhouensis* sp. nov.

B. CHONDRICHTHYANS——1, scales and teeth of cladodont sharks; 2, scales of ctenacanth sharks; 3, teeth of *"Phoebodus"* type; 4, teeth of *"Protacrodus"* type; 5, xenacanth tooth; 6, scales of bradyodont shraks, probably petalodontid; 7, teeth of *Harpagodens ferox* (Turner 1982).

C. PLACODERMS——indeterminate remains.

Because the acanthodians scales are only found in the horizon GMII24, here we propose that the incoming of *Acanthodes guizhouensis* marks the Devonian-Carboniferous boundary at Muhua. This fossil may be a potential zone fossil for the base of the Lower Carboniferous. There are also no shark remains, *"Phoebodus politus"* for ins-

tance, may prove to be useful as zone fossils for the Upper Devonian when we know more about their distribution in space and time. From a comparison of vertebrate faunas from Muhua with those found elsewhere it will be seen that vertebrate microfossils can be used with effect to provide a broad international correlation, and thus can be significant in the study of the Devonian-Carboniferous boundary problem.

Systematic Descriptions

Subclass Elasmobranchii

A. TEETH

Order Euselachii

Family Phoebodontidae

Genus *Phoebodus* St John et Worthen 1875

Phoebodus politus Newberry 1889

(pl. II, fig. 1; pl. III, fig. 2)

Two species definitely referrable to this form have been found. One species (GMII20—15) is broken but clearly shows the three main cusps, one central cusp and two lateral diverging cusps, with long and short slightly curved ribs ornamenting the dentinous surface. The base is mostly worn away exposing the internal basal vascular canals. The second specimen (21—14) is very waterworn but is more complete showing the more typical lingually-projecting base with the suggestion of an upper lingual 'button'.

Phoebodus sp.

(pl. II, figs. 2—3)

A tooth found in GMII20 might belong to a new species of this genus, or might be included in *P. politus* (GMII20—13). The tooth is 0.5 mm at the widest point across the cusps by 0.4 mm in height. The crown is made up of five cusps; the central cusp is narrow and smaller than the two lateral diverging cusps; in between these are two smaller cusps. All the cusps have a surface ornament of a few (less than four) slightly curving ribs. The cusps curve slightly to posterior. The base is elliptical in plan with a small rounded protuberance in the midpoint of the labial rim. On the upper lingual surface of the base are two slight swellings which might be relicts of a more pronounced lingual 'button'. The basal surface is gently concave.

A second tooth with broken cusps (20—14) may also belong to this form.

Remarks Teeth of *"Phoebodus"* spp., similar to and including, the *P. politus* type, are known from the Upper Devonian of the USA, Germany, India and Australia (Gross 1973, Gupta & Janvier 1979, Turner 1982). *P. politus* appears to be typical of the Late Devonian (Famennian).

Family Protacrodontidae nov.

Genus *Protacrodus* Jaekel 1921

Protacrodus? sp.

(pl. II, fig. 4)

One tooth (GM20—16) may belong to this genus. The tooth is rather worn but se-

ems to possess three low rounded cusps covered with several raised ribs. The angles between the cusps are occupied by a 'web' of the ribs of the cusps. At least nine riblets can be seen on the lingual surface of the lateral susps. The base is low and elongate with a slightly concave basal surface. Teeth of this genus are known in the Upper Devonian of Europe, the USA and Australia (Gross 1973, Turner 1982).

Family Incertae sedis

Genus *"Cladodus"* Agassiz 1843

***Cladodus*? sp.**

(pl. III, figs. 5—6)

One very waterworn tooth seems to belong to this form genus. The tooth from GMII (21—17) bears one large robust central cusp with no indication of lateral cusps. There is no sign of a shiny cusp surface; presumably the enameloid surface has been completely worn away. The base is slightly concave from side to side. About 10 main foramina are present in the lingual basal rim. The basal depression is slightly concave.

Cladodont teeth are preserved from the Middle Devonian to Permian; they are not easy to distinguish and many 'species' have been described. However, criteria are being developed by which to define genera and species and thus to assign cladodont teeth to phylogenetic taxa. Only one species, *Cladodus yunnanensis* P'an 1964, has been described from China.

Order Xenacanthida

Family Xenacanthidae

Genus *"Diplodus"*

***"Diplodus"* sp. cf. *"Diplodus" priscus* (Eastman)**

(pl. I, figs. 5—6; pl. III, figs. 3—4)

Several specimens, some broken and some waterworn, are teeth of xenacanth sharks nearest to the form called *"Diplodus priscus"* by Eastman (GMII21—15, 16; 20—5, 6). In these teeth there are a pair of stocky triangular cusps diverging at an angle of about 60—70°. In two teeth there is an indication of a very small median cusp (21—15, 20—5). The cusps show an indication of a series of a slightly curving ribs (21—15) on each side of the cusp. The base in the form is rounded and concave with quite a deep concave basal depression. Eight basal openings can be seen in one specimen (21—15). There is a slightly rounded lingual 'button' on the base.

"Diplodus" priscus comes from the uppermost Devonian of Illinois, USA.

Order Incertae sedis

Family Harpagodontidae nov.

Genus *Harpagodens* Turner 1982

***Harpagodens ferox* (Turner 1982)**

(pl. II, figs. 11—12)

1983, *Muhuadontus anchriformis* Xiong, pp. 33-52 pl. 1, fig. 15

One tooth from GMII20 is referred to this form described from the Upper Devonian-Lower Carboniferous (Famennian-basal Tournaisian) of Australia. Unfortunately the tooth was broken and lost during examination; only the smaller of the three cusps remains. Two teeth from LMS-8 (early Tournaisian in age, the other section of Muhua) horizon are referred to *H. ferox* (pl. II, figs. 11—12). A cusp found in GMII21(-19) also probably belongs to this species. This form has already been identified from the basal Carboniferous of this section in China; it was described as a conodont and called *Muhuadontus anchriformis* by Xiong in Xiong & Chen (1983, pl, 1, fig. 15).

This unusual tricuspid form has been found in Queensland and New South Wales, Australia (Turner 1982, 1983). It also occurs in the basal Carboniferous of Britain (C. Duffin, G. Sevastopulo, pers. comm.) A very similar, if not identical, tooth form from the Kinderhookian of the USA was called *Diplodus incurvus* by Newberry and Worthen (1866) and *Thrinacodus* by St John and Worthen (1875).

B. SCALES

Order Petalodontida

Family Petalodontidae

Genus *Petalodus*

Petalodus? daihuaensis Wang et Turner sp. nov.

(pl. I, figs. 8—12; pl. III, fig. 1)

Paratypes Nos. GMII20 —8 and 9; based on scales.

Derivation of name *daihuaensis* L. -from Daihua.

Material 6 scales (GMII20—8, 9, 10, 11, 12; GMII21—13).

Diagnosis Small columnar scale, crown round or rhombic in outline with a flat, smooth surface, a round pit in the center, possibly covered with shiny enameloid. Neck smooth and usually as high as the crown. The base is as the crown with a flattened ventral surface; there is a small central basal concavity. The basal tissue is finely pitted. Small pores are present near the neck-base interface.

Measurements The scales range in length from 0.1 to 0.2 mm, in width from 0.1 to 0.18 mm; depth ranges from 0.18 to 0.25 mm.

Locality and horizon Muhua, Changshun County, Guizhou Province, South China; Upper Devonian (Famennian), Daihua Fm., GMII20 and GMII21.

Description All the scales are very similar and about the same size. Most are small, rounded columnar scales with the crown slightly larger than the base (GMII20—11). Small pores can be seen in the neck of some scales (20—9). One scale has a more rhombic, diamond-shaped crown (20—12).

Discussion No histological examination of these scales has yet been made as there are so few specimens. However, they do appear to have a dentine crown with a dense shiny 'enameloid' surface. The base is made of a less dense tissue (20—11); a view into the basal depression reveals several interconnecting pulp canals (GMII20—12, 11, 9, 13).

Similar scale forms from the Late Pennsylvanian of the USA were illustrated but not described by Tway and Zidek (1983, figs. 67, 69, 71, 73). The Chinese scales have

been referred to the petalodontid group of sharks which are known from the early Carboniferous to Permian in Europe and America; it is not improbable that this new form of shark scale belonged to a very early representative of the group. We tentatively assign the scales to the genus "*Petalodus*". Similar mushroom-shaped scales are known from some other sharks, *Janassa bituminosa* for example (Orvig 1966).

Family Ctenacanthidae

ctenacanth shark scale type A

(pl. I, fig. 7)

On scale (GMII20—7) resembles ctencanth scales from Upper Devonian sharks of the USA (Dean, 1909). It has a relatively flattened wide rounded crown with two median rounded posterior extensions. There are nine or ten single and bifurcated ribs on the crown surface which narrow posteriorly. The crown is more wide than long. There is a narrow constricted neck and a thin rectangular base placed anteriorly. The basal surface is gently concave. This is a very waterworn scale and there is much pitting on the underside of the crown.

Class Placodermi?

Three scales, or tesserae, might be body scales or tubercles of placoderms (placoderms or sharks: GMII21—6, 7; placoderm: 21—12). Two with a high posteriorly-pointed crown and radiating riblets would seem to belong to the same animal. The third (21—12) resembles the body scales of some Devonian arthrodires. It is square in outine, with two posteriorly-directed striated spinelets, from which radiate small riblets to the edge of the skirt-like fringe of the scale. The basal surface is concave and there is a irregularly-crenulated scale rim.

Subclass Acanthodii

Order Acanthodiida

Family Acanthodidae

Genus *Acanthodes* Agassiz 1833

Acanthodes guizhouensis Wang et Turner sp. nov.

(pl. III, figs. 8—10)

Paratypes scales GMII24—1,3.

Material 8 scales (GMII24—1, 2, 3, 4, 5, 6, 7,8).

Derivation of name *guizhouensis* L. -from Guizhou.

Diagnosis Small rhombic scales with a thin rhombic crown with a smooth flat shiny top. Narrow constricted neck. Rounded bony base.

Locality and horizon Muhua, Changshun County, Guizhou Province; Lower Carboniferous (Tournaisian), Daihua Formation, GMII24, localized to the *Siphonodella sulcata* zone interval.

Measurements Scale length ranges from 0.3 to 0.38 mm; width from 0.25 to 0.3 mm; depth from 0.22 to 0.25 mm

Description　All the scales have smooth, triangular crowns. Most crowns are flat; some have a slight concavity in the centre of the surface. The anterior margin of the crown is gently curved whereas the posterior margin is formed into a posterior point by the lateral edges meeting at an obtuse angle. The neck is invariably narrow and smooth, as is the undersurface of the crown. The base is usually deep and rounded with some indication of incremental growth lines in the dense bony tissue. The basal surface is convex.

Discussion　The Chinese scales are very similar to those of *Acanthodes australis* Woodward 1906 from the Lower Carboniferous (Tournaisian) of Mansfield, Victoria. These scales are also found in the Upper Telemon Formation of the Drummond Basin, central Queensland, Australia. Other *Acanthodes* species are recorded from the Lower Carboniferous; These are *A. nitidus* from the Calciferous Sandstone, Glencartholm Group, Scotland; *A. evensis* from the Cementstone, Berwickshire Scotland; *A. sulcatus* from the Lower Oil Shale Group, Fife & Midlothian, Scotland; *A.* sp. from the Visean Upper Witteberg Series of South Africa (Denison 1979). The genus *Acanthodes* ranges into the Lower Permian. Denison (1979, p. 46) dismissed the Devonian records of the genus which are all based on scales alone; he surmized that the Devonian scales did not belong to *Acanthodes sensu stricto,* but simply resembled the scales of that genus in the possession of flat smooth shiny crown. Histological examination of the Devonian scales suggested that they do not belong to *Acanthodes.* The whole family is in need of revision, especially in the investigation of the histological structure of the scales. Scales of *A. guizhouensis* will be investigated histologically in the near future. It seems probable that, in the long run, *A. guizhouensis* might be put into synonymy with one of the above-mentioned Lower Carboniferous species. For now, because this is the first record of the family in China, we are conferring a new specific name.

The genus *Acanthodes* has a wide distribution in the Carboniferous, in America, Europe, South Africa and Australia as well as China. There is a more restricted geographical range in the Permian (Europe and North America only). In China, as elsewhere, scales of an *Acanthodes* species are found incoming at the base of the Carboniferous. In South China, *A. guizhouensis* has not been found in older strata, or in association with the shark and placoderm faunas. Furthermore it has been found only in the *Siphonodella sulcata* zone. Therefore it seems to have potential as an indicator fossil for the Lower Carboniferous in China.

Class, Order and Family Incertae sedis
Genus *Conchodontus* Wang et Yin 1984
Conchodontus ziegleri Wang et Yin 1984

(pl. I, figs. 1—4; pl. II, fig. 5)

1984, *Conchodontus ziegleri* Wang et Yin, pp. 224—238, pl. III, figs. 26—31.

Material　15 scales.

Locality and horizon　Muhua, Changshun County, Guizhou Province, South China; Upper Devonian (Famennian), Daihua Formation, GMII20 and 21.

Description　All specimens which belong to this form are small, around 0.6 mm in length and rounded in shape. In some specimens (GMII20—1, 2, 4) there are irre-

gularly placed nodules on the crown surface; the crown rim is slightly wavy in outline. The neck in all scales is a shallow, smooth constriction. The base is a thin annular ring smaller than the crown and placed anteriorly; it surround a deep concave basal depression. In the cavity concentric lines closely spaced can be seen in some specimens. There are three specimens which are triangular in shape and have the crown nodules arranged in radiating placed rows (GMII2)—3; 21—11, LMS-15). In all the scales the base is offset to one side, especially in the triangular shaped specimens. The nodules on the crown of other scales may be arranged irregularly.

Discussion No histological examination of this form has yet been made and so we are not certain of its systematics and relationships. However, as it is similar to some vertebrate remains, it should be described and figured in this paper. This form has been described and figured before. An identical scale was discovered in sample 3323 section 1, Grunen Schneid, Austria (no. 129 boundary marker) by Gedik (1974). He did not determine the specimen but illustrated it with conodonts (Gedik 1974, pl. I, figs. 23—25).

Recently this form has been described and referred to conodonts, they are named as *Conchodontus ziegleri* Wang et Yin and *C.* sp. (Wang & Yin 1984). In this paper the authors suggest that they might be referred to vertebrates. Mainly because the other scales (sharks or placoderms scales, GMII21—4, 6, 7; pl. II, figs. 8—9) also have the large and open concave cavity on the basal surface as well as the *Conchodontus,* while, they have not been found yet in the evolutionary lineage of the conodonts. So the authors described this form above in this paper as fish scales, we believe that the interesting microfossils could be resolved about their referring of the systematics.

Conchodontus sp.

(pl. II, figs. 6—7)

Two specimens (GMII21—2, 3) are nearly rectangular in shape, with irregularly-nodules, but no ridges of nodules, on the crown surface. A deep, open and elliptical concave basal depression on the basal surface. Other characters are similar to those of *Conchodontus ziegleri* Wang et Yin.

Locality and Horizon Muhua, Changshun County, Guizhou Province; Upper Devonian (Famennian), Daihua Formation,GMII21.

The Significance of the Vertebrate Microfossils of the Devonian-Carboniferous Boundary

In the Muhua section there are two distinct vertebrate associations. The faunal assemblage in the uppermost part of the Daihua Formation (GMII20 and 21), which corresponds to the *Siphonodella praesulcata* zone, comprises elasmobranch and possible placoderm remains. The sharks include forms such as *Phoebodus* spp., *Harpagodens ferox* and ctenacanth scales which appear elsewhere in the Late Devonian. With the incoming of the *Siphonodella sulcata* zone there appears a new element, *Acanthodes guizhouensis,* which is not found in older horizons. No other vertebrate remains have been found in the GMII24 level of the Gedongguan Bed (see Table 1).

Large vertebrate fossils (so-called macrofossils) have only rarely been found in the marine Upper Devonian and Carboniferous of China. For instance, *Cladodus yunnanensis* P'an 1964 is the only recorded shark from this period. Microvertebrate remains, however, are being found commonly in Palaeozoic rocks of both non-marine and marine origin, and often in association with conodonts of different facies assemblages. This is no less so in China. Vretebrate microfossils can be used successfully to give a date to a rock sample, albeit in a broad range such as "late Upper Devonian" (Turner 1982). The main conclusion of the work of the past few decades on the use of vertebrate microfossils, such as agnathan thelodont scales, is that they can prove useful in biostratigraphy (Gross 1967, Turner 1973, Karatajute-Talimaa 1978). This is especially so when only small samples are available, as from boreholes, and when other diagnostic fossils are absent, as in some terrestrilly-derived sediments. The same conclusion applies to the use of shark remains, particularly, in Palaeozoic rocks.

A system of numerical taxonomy applied to fish microremains was introduced recently by a team of workers in America; it is called Stratignathy (Doyle et al 1974, Tway & Zidek 1982, 1983). Proponents of this method refer to fish remains as "ichthyoliths". We believe this system must be treated with caution because it treats solely with the superficial morphology of individual specimens and does not attempt to identify the true nature of the remains as revealed by their structure and histology. It is important to retain the classic binominal system for all vertebrate fossils, including microremains; for it is just as necessary even when, as in some cases and by analogy with conodonts, the exact nature of the animal to which a specimen belongs is not immediately discernible.

As an example of the difficulties which can arise, there is the case of a form associated with the vertebrate microfossils in samples F12 and F11; this form has recently been referred to the Conodonta by Wang and Yin (1984) as *Conchodontus ziegleri*. Superficially these organisms resemble shark scales; they are small, around 1 mm, rounded with a posterior point, and divided into crown, neck and base. The basal part is wide open like a young thelodont scale, and growth lines can be seen in the basal tissue. However, as Wang and Yin almost certainly decided correctly, the tissues from which the scales are composed do not exactly resemble dentine or bone in texture. In this case, a study of the histology by thin section would be most interesting and should help to resolve in which group *Conchodontus* belonged.

The study of the use of vertebrate microfossils in biostratigraphy is still in its infancy. There is a need to discover which fish populations experienced fast evolution or made rapid dispersal. Undoubtedly, as with conodonts, certain faunal elements are facies-controlled. However, it seems probable that many early fish were capable of withstanding a wide range of salinity change and thus can appear in a wide range of sediment types. We are not advocating the sole use of vertebrate to determine the age of strata; rather, we advocate their use in conjunction with invertebrates and vertebrate macrofossils. Furthermore, one more detailed knowledge of the sequence of microvertebrate faunas in the rocks of any one county is obtained that it is possible to make an assessment of the age of rocks; with that information microvertebrates can play a role in the subdivision of system, series and stages.

TABLE 1 The distributions of the vertebrate microfossils and *Conchodontus* from the Muhua section II of the Devonian—Carboniferous Boundary in Changshun County, Guizhou Province.

	UPPER DEVONIAN (Famennian)					L. CARBON. (Tourn.)
	Daihua Formation		Gedongguan Bed			
	GMII 20	GMII 21	GMII 22	GMII 23	GMII 24	
Acanthodes guizhouensis sp. nov.					X	
Phoebodus politus	X	X				
p. spp.	X	X				
Protacrodus? sp.	X					
Cladodus? sp.		X				
Diplodus cf. *priscus*	X	X				
Harpagodens ferox	X	X				
Petalodus? *daihuaensis* sp. nov.	X	X				
Placodermi? scales		X				
ctenacanth shark scale	X					
Conchodontus ziegleri	X	X				
C. spp.	X	X				

Conclusion

The different charateristics of the lower and upper vertebrate microfossil assemblages and the *Acanthodes guizhouensis* assemblage of the Devonian-Carboniferous boundary in the Muhua section, Guizhou Province show that vertebrate microfossils do have universal significance for the boundary. The true "*Acanthodes*" should occur from the basal Carboniferous onward. This might help us to recognize the Devonian-Carboniferous boundary elsewhere.

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图　版　说　明

本文描述的化石均为野外样品登记号；图版次序按化石出现层位编制。全部标本保存于北京地质博物馆。

图　版　I

1—4，齐格勒壳齿刺 *Conchodontus ziegleri* Wang et Yin, (GMII20-1,2,3,4)；
1a, 2a, 3a, ×60, 4a ×90, 冠面视 (crown view)；1b, 2b, 3b ×72, 4b ×120, 基面视 (basal view)；

5—6，双鲨未定种 *Diplodus* spp., (GMII20-5,6)
5a ×60, 唇面视 (labial view)；5b ×90, 6×60, 舌-基面视 (linguo-basal view)；

7，栉棘鲨类鳞片类型A ctenacanth shark scale type A, (GMII20-7) ×60
7a, 冠面视 (crown view)；7b, 基面视 (basal view)；

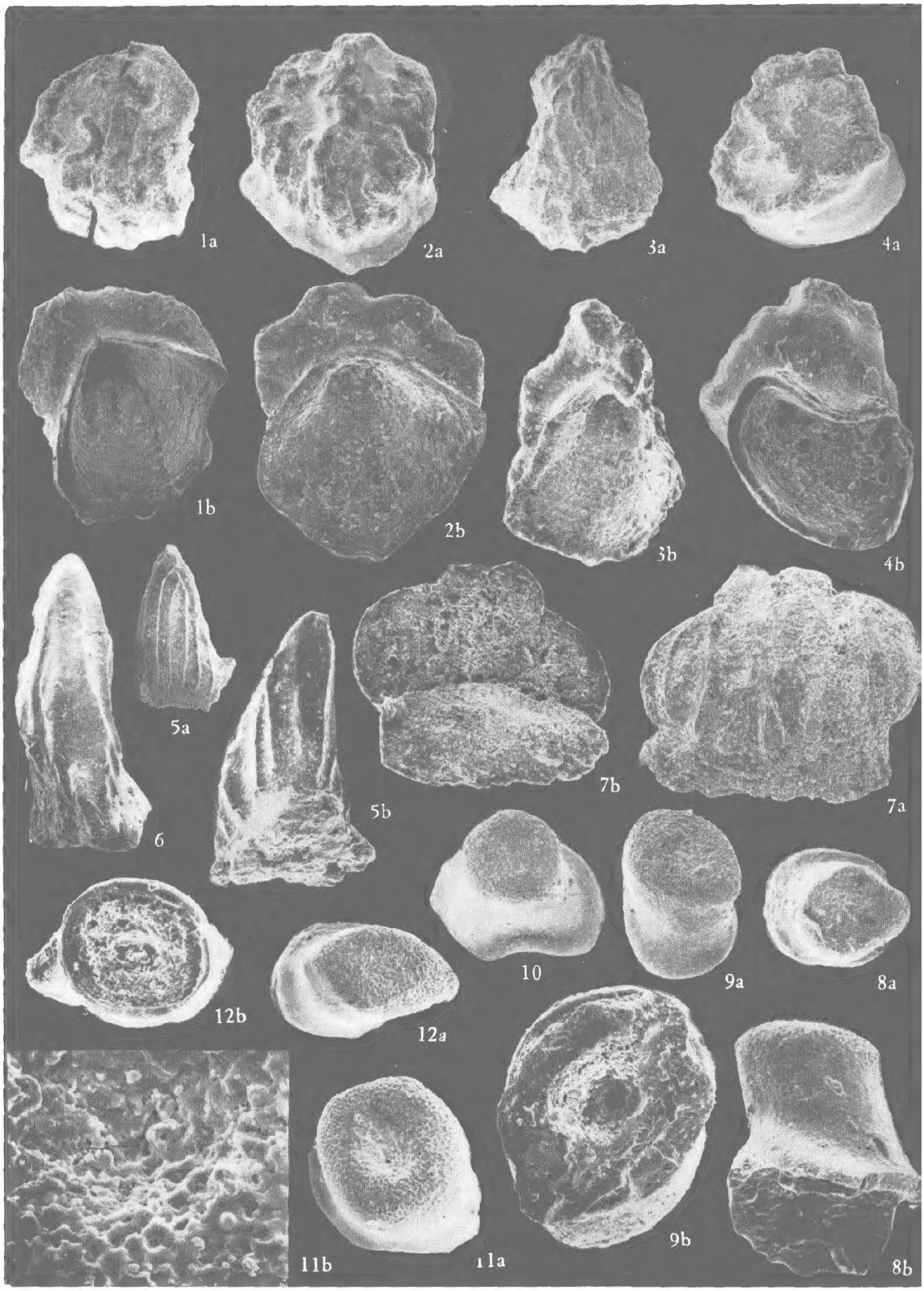
8—12，代化瓣齿鲨(新种) *Petalodus? daihuaensis* Wang et Turner sp. nov., (GMII20-8, 9, 10, 11, 12)
副型标本 (Paratypes): Nos. GMII20-8,9
8a, 10a, 11a, 12a ×120, 9a ×90, 冠面视 (crown view)；
8b ×180, 侧-基面视 (latero-basal view)；9b, 12b ×180, 基面视 (basal view)；11b ×600, 11a (冠面的局部放大)

图 版 II

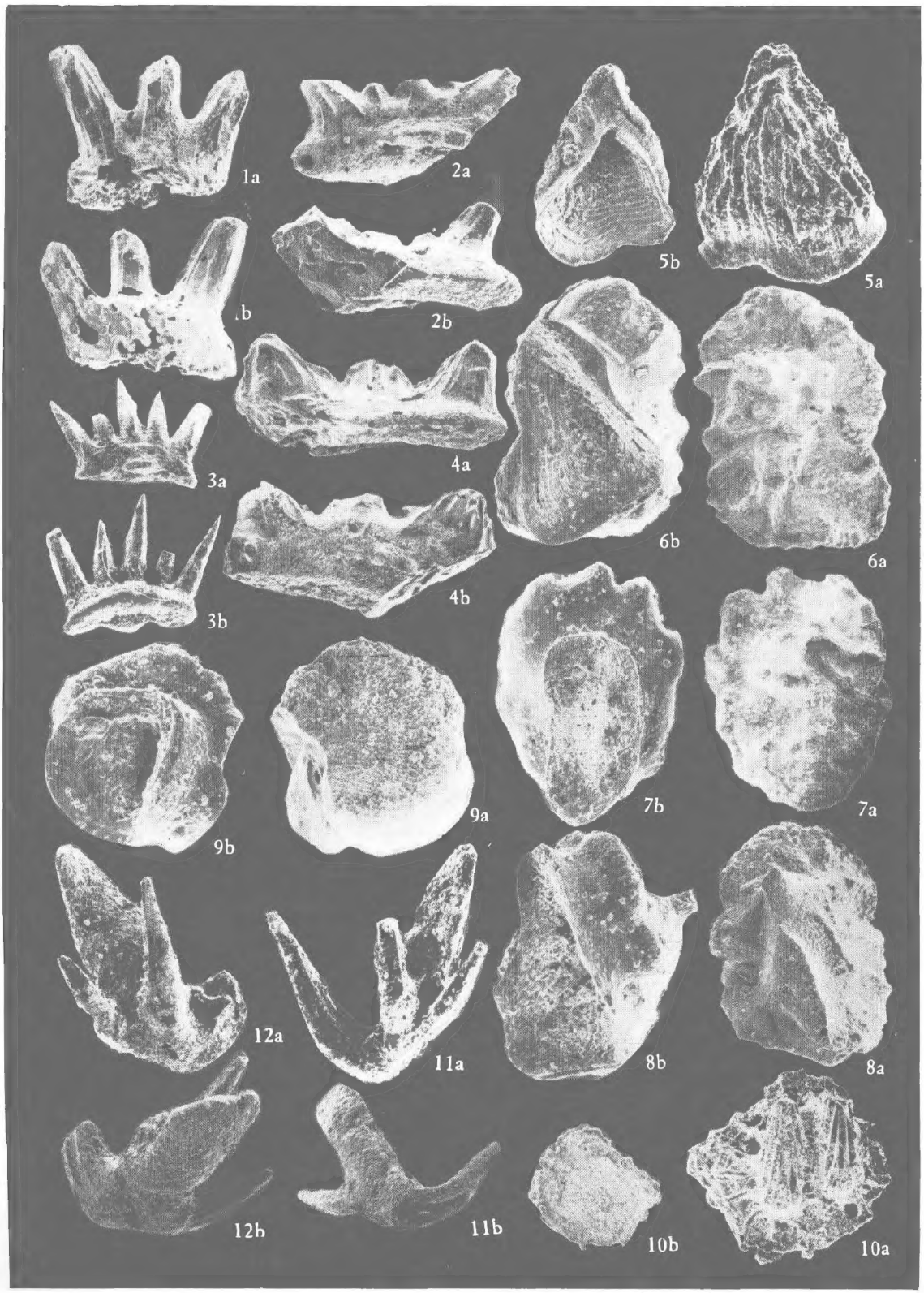
1，平滑亮齿鲨 *Phoebodus politus* Newberry, (GMII20-15) ×72
a, 唇面视 (labial view); b, 舌-基面视 (linguo-basal view);
2—3，亮齿鲨未定种 *Phoebodus* spp., (GMII20-13, 14) ×60
2a, 3a, 唇面视 (labial view); 2b, 3b, 舌-基面视 (linguo-basal view);
4，原尖齿鲨? 未定种 *Protacrodus*? sp., (GMII20-16) ×60
4a, 唇面视 (labial view); 4b, 舌-基面视 (linguo-basal view);
5，齐格勒壳齿刺 *Conchodontus ziegleri* Wang et Yin, (GMII21-11)
5a ×72, 冠面视 (crown view); 5b×60, 基面视 (basal view);
6—7，壳齿刺未定种 *Conchodontus* spp., (GMII21-2,3)
6a, 7a×90, 冠面视 (crown view); 6b, 7b×90, 基面视 (basal view);
8—9，鲨类或盾皮鱼类(?)鳞片 shark or placoderm (?) scales, (GMII21-6,7)
8a×90, 9a×120, 冠面视 (crown view); 8b×90, 9b×120, 基面视 (basal view);
10，盾皮鱼类? 鳞片 placoderm? scale, (GMII21-12)
10a×60, 冠面视 (crown view); 10b×40,基面视 (basal view)
11—12，凶暴钩齿鲨 *Harpagodens ferox* Turner, (LMS-8)
11a ×75, 背-唇视 (dorso-labial view); 11b ×65, 腹视 (ventral view);
12×65, 12a, 背-唇视 (dorso-labial view); 12b, 腹视 (ventral view)

图 版 III

1，代化瓣齿鲨(新种) *Petalodus? daihuaensis* Wang et Turner sp. nov., (GMII21-13) ×90
1a, 冠面视 (crown view); 1b, 基面视 (basal view);
2，平滑亮齿鲨 *Phoebodus politus* Newberry, (GMII21-14) ×60
2a, 唇面视 (labial view); 2b, 舌-基面视 (linguo-basal view)
3—4，双鲨未定种 *Diplodus* spp., (GMII21-15,16) ×90
3a, 4a, 唇面视 (labial view); 3b, 4b, 舌-基面视 (linguo-basal view);
5—6，裂齿鲨? 未定种 *Cladodus*? spp., (GMII21-17, 18)
5a×36, 6a×72, 唇面视 (labial view); 5b×36, 舌-基面视(linguo-basal view); 6b×72, 基面视 (basal view);
7，钩齿鲨未定种 *Harpagodens* sp., (GMII21-19) ×60
一破裂的齿尖 (a broken cusp);
8—10，贵州棘鱼(新种) *Acanthodes guizhouensis* Wang et Turner sp. nov., (GMII24-3,1,2) ×120
副型标本 (Paratypes): Nos. GMII24-1,3
8a, 9a, 10a, 冠面视 (crown view); 8b, 9b, 10b, 基面视 (basal view); 10c, 侧视 (lateral view)



（图版说明请见 233 页）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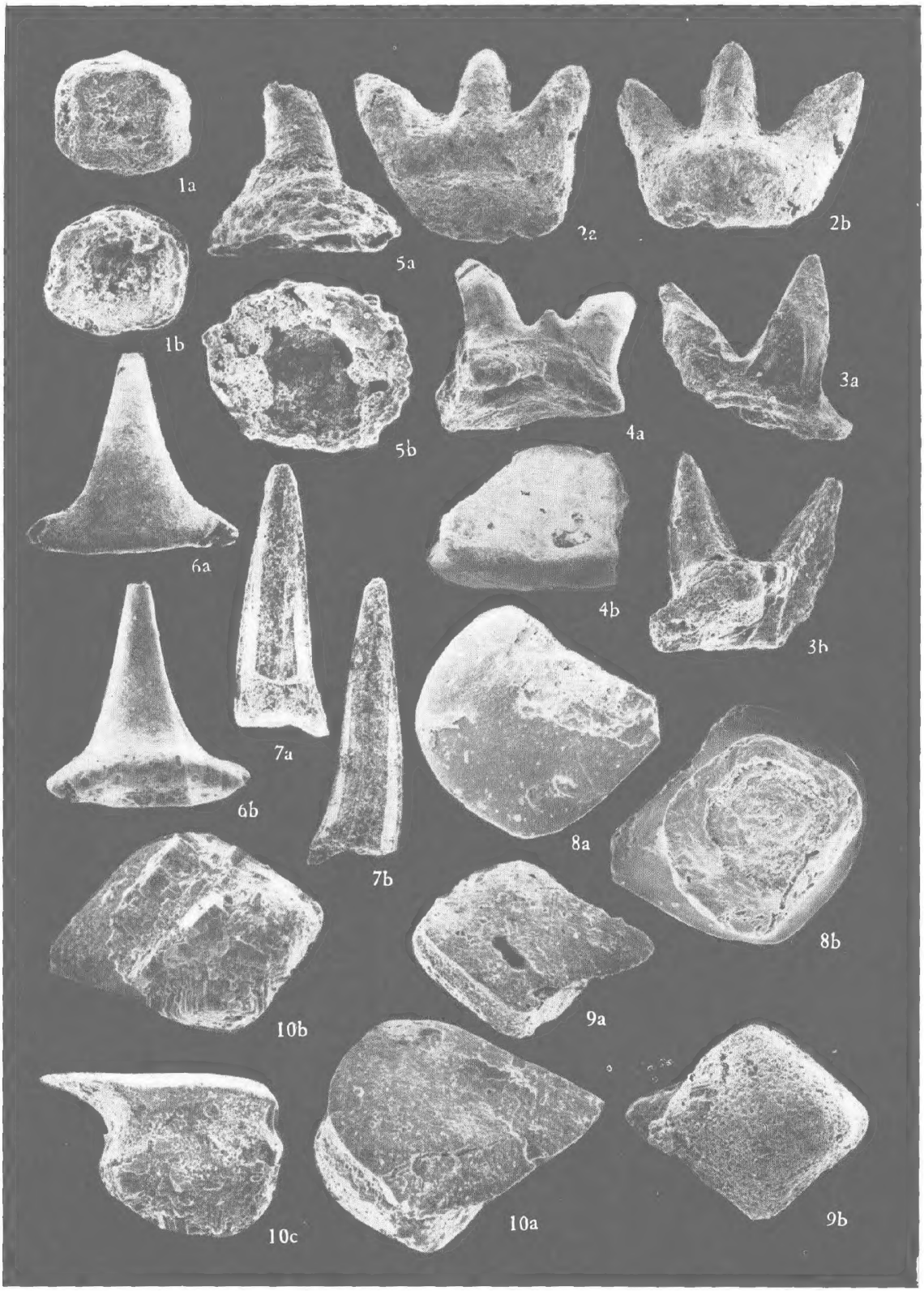
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9a
10c
10a
9b